

ON THE GRADING AND IDENTIFICATION OF DOMESTIC
COMMERCIAL SHRIMPS (FAMILY PENAEIDAE) WITH
A TENTATIVE WORLD LIST OF COMMERCIAL
PENAEIDS

BONNIE ELDRED AND ROBERT F. HUTTON

*Florida State Board of Conservation Marine Laboratory*¹

INTRODUCTION

The shrimp industry in the United States has grown yearly due to the consumers' demand for shrimp and shrimp products. According to the Commercial Fisheries Review (1959) the 1958 domestic production of shrimps (heads-on) in the United States was approximately 212 million pounds valued at 76 million dollars. In addition to the domestic supply, about 86 million pounds of headless shrimps from 39 foreign countries were imported into the United States during 1958.

The imports of frozen raw headless shrimps, composed of many unfamiliar species, and the lack of reliable criteria to distinguish the domestic headless shrimps present problems connected with developing grade standards. Charles F. Lee, Technological Laboratory, U. S. Bureau of Commercial Fisheries, College Park, Maryland, working with others on developing voluntary grade standards intended mainly for the packer-grader-distributor of frozen raw headless shrimps, feeling that the color of the headless shrimps and 'the presence or absence of a "groove" are almost valueless' in identifying headless shrimps, wrote us concerning the possibility of identifying shrimps by observations of the "tail" portion only. Several papers in reference to identifying domestic heads-on commercial shrimps have been published (Broad, 1949; Voss, 1955; Anderson, 1958; and others), but much confusion still exists in the identification of these species, especially when headless.

Mr. Lee also included a copy of a tentative draft, designated as "Review Draft No. 2, U. S. Standards for Grades of Frozen Raw Headless Shrimp," for our opinion concerning the feasibility of applying Section 1. of this draft to the grading of domestic and foreign shrimps by in-plant inspectors trained in food technology but lacking knowledge of shrimp biology. Section 1. follows:

¹ Contribution No. 46 from The Fla. State Board of Conservation Marine Lab. Maritime Base, Bayboro Hrbr. St. Petersburg, Florida.

Product description. Frozen raw headless shrimp are clean, wholesome, headed, shell-on shrimp of regular commercial species of the genus *Penaeus* and other species of similar characteristics. (In order to promote fair marketing practices the common color designation—white, pink, brown, etc.,—should be indicated; and, if the shrimp are not *Penaeus*, the correct species name or the recognized common name, if any, must be used to identify the product.) . . . ”

In this report we have attempted to clarify some of the factors related to shrimps that perplex those involved in developing grade standards. A brief history and the distribution are presented on the commercial shrimps (tribe Penaeidea, family Penaeidae, and tribe Caridea) reported from domestic and foreign fisheries.

The vernacular terms, common color names, and the variable color characteristics of shrimps are discussed in regard to the promotion of fair marketing practices.

Although no attempt was made to provide identifying characters for foreign shrimps, reliable abdominal characters for identifying domestic commercial species (family Penaeidae) are described and illustrated.

HISTORICAL REVIEW

TRIBE PENAIDEA

Family Penaeidae

The major part of the world's production of shrimps is based on those species belonging to the family Penaeidae. This family is composed of about 27 genera which include over 200 described species (Milne-Edwards and Bouvier, 1909; Burkenroad, 1934a, 1934b, 1936a, 1938, and 1939; Anderson and Lindner, 1943; Kubo, 1955; Menon, 1955; Racek, 1955a; Dall, 1958). These shrimps are commonly called penaeids.

Approximately 66 species of 15 genera have been reported to our knowledge in the commercial fisheries of various parts of the world. These species and their general distribution are shown in Table I.

Table I is based on reports by Burkenroad (1936a, 1938, and 1939); Cheung (1959); Heldt (1938); Holthuis (1959); Holthuis and Gottlieb (1958); Hudinaga (1942); Kesteven and Job (1957); Lindner (1957); Lunz (1957); Racek (1955a); U. S. Fish and Wildlife Service (1958); Villadolid and Villaluz (1951); and reports published in the Proceedings of the Indo-Pacific Fisheries Council,

TABLE I
A WORLD LIST OF THE COMMERCIAL SHRIMPS (FAMILY PENAEIDAE) REPORTED IN
DOMESTIC AND FOREIGN FISHERIES.

SPECIES	DISTRIBUTION (WHERE FISHERY OCCURS)
<i>Solenocera membranacea</i> (H. Milne-Edwards) <i>Hymenopenaeus robustus</i> Smith <i>H. mulleri</i> (Bate)	Sub-family Solenocerinae Mediterranean Gulf of Mexico and Atlantic North America Atlantic South America
<i>Aristaeomorpha foliacea</i> (Risso) <i>Aristeus antennatus</i> (Risso)	Sub-family Aristeinae Mediterranean Mediterranean
<i>Penaeus duorarum</i> Burkenroad (Form A)* <i>P. duorarum</i> Burkenroad (Form B)* <i>P. aztecus</i> Ives (Form A)* <i>P. aztecus</i> Ives (Form B)* <i>P. aztecus</i> Ives (Form C)* <i>P. brasiliensis</i> Latreille*	Sub-family Penaeinae Gulf of Mexico and Atlantic North America Caribbean, Atlantic Central America (possibly west coast of Africa) Gulf of Mexico, Atlantic North America, and Caribbean Caribbean and Atlantic South America Atlantic South America Caribbean and Atlantic South America (possibly Atlantic North America)
<i>P. setiferus</i> (Linn)** <i>P. schmitti</i> Burkenroad** <i>P. stylitrostris</i> Stimpson** <i>P. vancouveri</i> Boone**	Gulf of Mexico and Atlantic North America Caribbean, Atlantic Central America, and Atlantic South America Pacific Central America and Pacific South America Pacific Central America and Pacific South America

TABLE I—Continued
 A WORLD LIST OF THE COMMERCIAL SHRIMPS (FAMILY PENAEIDAE) REPORTED IN
 DOMESTIC AND FOREIGN FISHERIES.

SPECIES	DISTRIBUTION (WHERE FISHERY OCCURS)
<i>P. occidentalis</i> Streets**	Pacific Central America and Pacific South America
<i>P. brevistrotris</i> Kingsley*	Pacific Central America
<i>P. californiensis</i> Holmes*	Pacific Central America
<i>P. penicillatus</i> Alcock**	Indo-Pacific
<i>P. kerathurus</i> (Forsk.)*	Indo-Pacific and Mediterranean
<i>P. semisulcatus</i> De Haan**	Indo-Pacific and Mediterranean
<i>P. japonicus</i> Bate*	Indo-Pacific and Mediterranean
<i>P. caeruleus</i> Stebbing**	Indo-Pacific
<i>P. maccullochi</i> Schmitt*	Indo-Pacific
<i>P. carinatus</i> Dana**	Indo-Pacific
<i>P. indicus</i> H. Milne-Edwards**	Indo-Pacific
<i>P. canaliculatus</i> Oliver*	Indo-Pacific
<i>P. merguensis</i> De Man**	Indo-Pacific
<i>P. plebejus</i> Hess*	Indo-Pacific
<i>P. esculentus</i> Haswell*	Indo-Pacific
<i>P. latisulcatus</i> Kishinouye*	Indo-Pacific
<i>P. orientalis</i> Kishinouye**	Indo-Pacific
<i>P. monodon</i> Fabr.**	Indo-Pacific
<i>Artemia longinaria</i> Bate	Atlantic South America
<i>Parapenaeus longirostris</i> (Lucas)	Mediterranean
<i>P. fissurus</i> Bate	Indo-Pacific

TABLE I—Continued
 A WORLD LIST OF THE COMMERCIAL SHRIMPS (FAMILY PENAEIDAE) REPORTED IN
 DOMESTIC AND FOREIGN FISHERIES.

SPECIES	DISTRIBUTION (WHERE FISHERY OCCURS)
<i>P. lanceolatus</i>	Indo-Pacific
<i>Peneopsis (Metapeneopsis) dalei</i> Rathbun	Indo-Pacific
<i>P. (Metapeneopsis) novae-guineae</i> Haswell	Indo-Pacific
<i>P. (Metapeneopsis) coniger</i> Wood-Mason and Alcock	Indo-Pacific
<i>P. (Metapeneopsis) acclivis</i> Rathbun	Indo-Pacific
<i>P. (Metapeneopsis) barbatus</i> De Haan	Indo-Pacific
<i>P. (Metapeneopsis) lamellatus</i> (De Haan)	Indo-Pacific
<i>Metapeneus monoceros</i> Fabricius	Indo-Pacific and Mediterranean
<i>M. affinis</i> (H. Milne-Edwards)	Indo-Pacific
<i>M. dobsoni</i> Miers	Indo-Pacific
<i>M. brevicornis</i> H. Milne-Edwards	Indo-Pacific
<i>M. joyneri</i> Miers	Indo-Pacific
<i>M. macleayi</i> (Haswell)	Indo-Pacific
<i>M. masteri</i> (Haswell)	Indo-Pacific
<i>M. incisipes</i> (Bate)	Indo-Pacific
<i>M. endeavouri</i> (Schmitt)	Indo-Pacific
<i>M. burkenroadi</i> Kubo	Indo-Pacific
<i>Protrachupene precipua</i> Burkenroad	Pacific Central America
<i>Xiphopenaeus kroeyeri</i> (Heller)	Gulf of Mexico, Caribbean, Atlantic North America, and Atlantic South America
<i>X. riveti</i> Bouvier	Pacific Central America and Pacific South America

TABLE I—Continued
 A WORLD LIST OF THE COMMERCIAL SHRIMPS (FAMILY PENAEIDAE) REPORTED IN
 DOMESTIC AND FOREIGN FISHERIES.

SPECIES	DISTRIBUTION (WHERE FISHERY OCCURS)
<i>Atypopeneus compressipes</i> (Henderson)	Indo-Pacific
<i>Parapeneopsis stylifera</i> (H. Milne-Edwards)	Indo-Pacific
<i>P. uncta</i> Alcock	Indo-Pacific
<i>P. tenellus</i> (Ortmann)	Indo-Pacific
<i>P. sculptilis</i> (Heller)	Indo-Pacific
<i>P. maxillipedo</i> Alcock	Indo-Pacific
<i>P. cornutus</i> (Kishinouye)	Indo-Pacific
<i>Trachypeneus (Trachysalambria) similis</i> (Smith)	Gulf of Mexico
<i>T. (Trachysalambria) byrdi</i> Burkenroad	Pacific Central America and Pacific South America
<i>T. (Trachysalambria) faoe</i> Burkenroad	Pacific Central America and Pacific South America
<i>T. (Trachysalambria) curvirostris</i> (Stimpson)	Indo-Pacific and Mediterranean
<i>T. (Trachypeneus) anchoralis</i> (Bate)	Indo-Pacific
<i>Sicyonia brectrostris</i> Stimpson	Sub-family Sicyoniinae
	Gulf of Mexico and Atlantic North America

* Grooved

** Non-grooved

3rd Session (1951), 5th Session (1954), and 6th Session (1955), by many authors (cited in the references). Table I should be considered provisional since other genera and species of penaeids undoubtedly occur in the world's fisheries.

The geographical range of many of the species is not included in Table I. It lists only the general localities where these species have been reported in the fisheries.

Twenty-five species of the genus *Penaeus* (Table I) are reported in the domestic and foreign fisheries. Species of this genus, because of their abundance and relatively large size, compose the major part of the world's production of shrimps.

In addition to the genus *Penaeus*, 14 other genera including 41 commercial penaeid species are shown in Table I. Many of these shrimps, because of their small size or sporadic habits, are not of major importance to some countries, in others, even the smallest species are utilized.

Tribe Caridea

Several families of shrimps belonging to the tribe Caridea (commonly called caridean shrimps) are included in domestic and foreign production. Fisheries, based on shrimps of the families Pandalidae and Cragonidae, exist along the Pacific coast of the United States (Schaefers, 1953; Schaefers and Johnson, 1957; and Bonnot, 1932). Species of these families are also utilized in foreign countries (Mistakidis, 1957; Lindner, 1957; and U. S. Fish and Wildlife Service, 1958).

Shrimps of the family Palaemonidae are a part of the catches from many Indo-Pacific, Caribbean, and South American countries (Panikker and Menon, 1955; Lindner, 1957; and Holthuis, 1956, 1959). Species of the genera *Palaemon* and *Macrobrachium* (family Palaemonidae) are cultivated in fresh-water areas of some Indo-Pacific countries (Djadiredja and Sachlan (1955); and others). Specimens of *Macrobrachium* were observed on many occasions in the markets of Cuba and Mexico (Robert M. Ingle, personal communication). According to Viosca (1957) *Macrobrachium* specimens are taken in commercial quantities from fresh and slightly brackish waters of Louisiana.

Although the abdominal or "tail" portion of the shrimps of both the Penaeidea and Caridea consist of six segments and the tail fan, the two tribes are readily separated. In the Penaeidea the

second (anterior) abdominal segment overlaps only the third segment (Figure 1). In contrast, in the Caridea the second abdominal segment overlaps both the first and the third segment in a saddle-like manner (Figure 2).

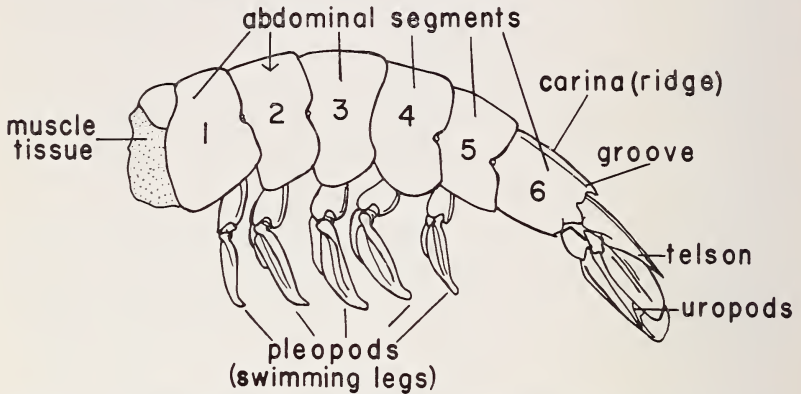


Figure 1. Abdominal or "tail" portion of a penaeid shrimp (lateral view).

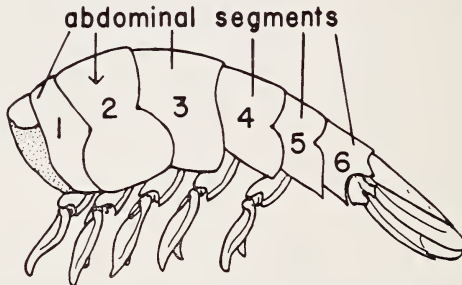


Figure 2. Abdominal or "tail" portion of a caridean shrimp (lateral view).

VERNACULAR TERMS AND COMMON COLOR NAMES

Certain vernacular terms, applied to shrimps, have different localized connotations, but no standard universal meanings. Many such terms are actually synonymous with the word "shrimp" and are applied to a penaeid, caridean, deep-sea, offshore, inshore, salt-water, fresh-water, small, or large shrimp.

Prawn and shrimp. Many persons have interpreted the term "prawn" to mean large specimens and the term "shrimp" to mean small specimens. Others have confined the term "prawn" to salt-water specimens and the term "shrimp" to fresh-water specimens.

Voss (1955) classified those species of the tribe Caridea as "prawns" and those species of the tribe Penaeidea as "shrimps".

Many authors from England, India, and Australia apply the term "prawn" only to species of the Penaeidea.

Publications (English translations) by authors from Indo-Pacific countries assign the terms "prawn" or "shrimp" to species of both the tribes Penaeidea and Caridea.

Mistakidis (1957) used the common name "pink shrimp" for the caridean, *Pandalus montagui*, while Cole (1958) and others employed "prawn" for *Palaemon serratus*, *Pandalus borealis*, and other carideans. *P. borealis*, *P. platyceros*, *P. hypsinotus* and other commercial carideans from the North American Pacific are called "shrimps" (Schaefers, 1953).

Although the generally accepted term "shrimps" is used for those species in the domestic catch, extremely large specimens of *Penaeus setiferus* from the offshore waters of Louisiana are at times called "Gulf prawns" (Viosca, 1957).

Langostino and camaron. According to Lindner (1957) the generally used terms, throughout Latin America, are "langostino" for large shrimp and "camaron" for small shrimp. In Mexico "camaron" is used for all salt-water shrimps, and "langostino" is employed for fresh-water palamonids of the tribe Caridea. Lindner reported that in Chile all marine and fresh-water shrimps are called "camaron" and the lobster-like crustaceans of the family Galathaeidae are called "langostino".

Grooved and non-grooved shrimps. These terms are commonly associated with the domestic commercial species; for example, *P. setiferus* is called the non-grooved shrimp because of the absence of grooves on the head and "tail", whereas, *P. duorarum* and *P. aztecus* are called grooved shrimps because of the presence of grooves. Other grooved and non-grooved species of the genus *Penaeus* occurring in the foreign fisheries are designated in Table I.

Other vernacular terms associated with foreign shrimps are too numerous to mention here but may be found in the reports of many workers.

Shrimps throughout the world assume many colors. This coloration is due to small color bodies (chromatophores) scattered or grouped in patterns. These chromatophores, when expanded, color the shrimps pink, brown, green, etc. When the chromato-

phores are contracted the shrimps appear white or colorless. This process of coloration, generally associated with the habitats or behavior of the shrimps, provides protection. The coloration of one species may vary greatly with the growth, environment, and disease.

Because of variation of color within the species, the use of color names generally applied to shrimps can be a source of much confusion. Many species, sometimes of different families may assume the same coloration, thus, bear the same color name; also, one species may assume different colors, consequently, will bear many color names. Examples are shown in the following color groups:

1. *White shrimp.*

- a. The color "white" and the common name "white shrimp" are associated with the domestic commercial penaeid, *P. setiferus*, especially those specimens from the coast of Louisiana and Texas.
- b. We have seen many "white" or "colorless" specimens of the domestic penaeid, *P. duorarum*, from the west coast of Florida.
- c. Penaeid shrimps from foreign fisheries, such as *P. stylirrostris*, *P. occidentalis*, *P. vannamei*, *P. schmitti*, *P. aztecus*, are often "white" and at this time are called by the natives "white or blanco shrimp" (Lindner, 1957).

2. *Pink shrimp.*

- a. The domestic commercial penaeid, *P. duorarum* (Form A), produced from the Campeche and Tortugas shrimping grounds of the Gulf of Mexico is generally "pink" in color and the common name "pink shrimp" is associated with this species.
- b. The small penaeid, *Trachypeneus similis*, abundant in the Campeche and Tortugas areas is also "pink" in color. Very small "pink" specimens of *T. constrictus* are abundant on the Tortugas grounds. These species of *Trachypeneus* are possibly mistaken by shrimpers for young specimens of *Penaeus aztecus* or *P. duorarum* (Hildebrand, 1954; and Eldred, 1959).
- c. Several "pink" colored penaeid species occur in foreign fisheries, such as *P. duorarum* (Form B), *P. brasiliensis*, *P. brevirostris*, *Hymenopenaeus mulleri*, *Artemesia longinaris* (Lindner, 1957).
- d. Caridean species of "pink shrimps" belonging to the family Pandalidae, occurring in domestic and foreign fisheries are: *Pandalus jordani*, *P. borealis*, (Stern, 1957); *P. montagui* (Mistakidis, 1957); and *Heterocarpus reedi* (Lindner, 1957).

3. *Brown shrimp.*

- a. The names "brownies" and "brown shrimp" and the color "brown" are associated with the domestic commercial penaeid, *Penaeus aztecus* (Form A).

- b. Many "brown" colored specimens of *P. duorarum* occur in domestic catches from inshore areas.
 - c. The domestic commercial penaeid, *Xiphopeneus kroyeri*, commonly called the "sea bob", is "brown" in color.
 - d. Foreign penaeid species often called "brown shrimp" are: *Penaeus brasiliensis*, *P. californiensis*, *Protrachypene precipua*, *Trachypeneus faoe*, *T. byrdi*, and *Xiphopeneus riveti* (Lindner, 1957).
4. *Green shrimp*.
- a. Although *Penaeus setiferus* is often called the "white shrimp", this species is called the "green shrimp" in the Jacksonville, Florida, area.
 - b. According to De Sylva (1954), specimens of *P. duorarum* from the inshore waters of Florida, from New Smyrna to Fort Pierce, are called the "green shrimp". We have seen many "green" specimens of *P. duorarum* from other inshore areas.
 - c. We have obtained many "green" specimens of *P. aztecus* from the east coast of Florida. One of the common names for *P. aztecus* in Louisiana is "green lake shrimp" (Viosca, 1957).
 - d. Packages of imported frozen shrimp "tails" called "green shrimp" are found occasionally in one of the local super markets. These specimens were identified as *P. schmitti*.
5. *Gray shrimp*.
- a. Burkenroad (1949) referred to *P. setiferus* in the North Carolina fishery as the "gray shrimp". The use of this name was also reported by De Sylva (1954) for *P. setiferus* occurring north of New Smyrna, Florida. *P. setiferus* is often called the "gray shrimp" in Pensacola Bay, Florida.
6. *Red shrimp*.
- a. The name "red shrimp" was reported for *P. aztecus* from the east coast of Florida (De Sylva, 1954), and Texas (Broad, 1949).
 - b. *P. duorarum* is often called the "red shrimp" by live bait shrimp producers and retailers along both coasts of Florida.
 - c. The deep-water shrimp, *Hymenopenaeus robustus*, is known as the "royal red shrimp". Many other deep-water penaeids and carideans are "red" in color.
7. *Blue shrimp*.
- a. Although the blue chromatophores are often predominant on specimens of *Penaeus setiferus*, the name "blue shrimp" has not to our knowledge been applied to this species.
 - b. A predominance of the blue-black chromatophores found on many penaeid species is often associated with a diseased condition of the shrimp caused by microsporidian parasites (Sprague, 1950; Woodburn *et al*, 1957; Hutton *et al*, 1959; Kruse, 1959; and Iversen and Manning, 1959). These shrimps are called "cotton or milk shrimp" because of the unhealthy appearance of the abdominal musculature.

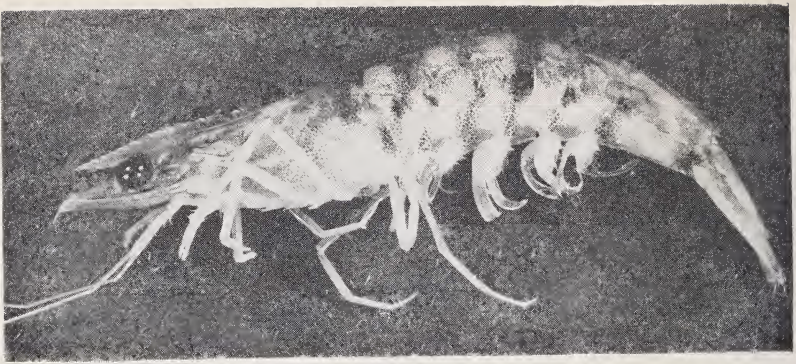


Figure 3. *Penaeus duorarum* (Form A), Cedar Key, Florida, with abdominal spot (lateral view).



Figure 4. *Penaeus duorarum* (Form A), Cedar Key, Florida, with faint indication of abdominal spot (lateral view).



Figure 5. *Penaeus aztecus* (Form A), Indian River, Florida, with abdominal spot (lateral view).

- c. Three species of penaeids produced from the Pacific coast of Central and South America (*P. stylirostris*, *P. vannamei*, and *P. occidentalis*) are often called "blue shrimps" (Lindner, 1957). Higman (1959) reported on the "blue shrimp" *P. schmitti* from the coast of Surinam. Racek (1955) gave the vernacular name "blue tiger prawn" for Indo-Pacific penaeid, *P. caeruleus*.
8. *Spotted shrimp*.
- a. The name "spotted shrimp" was applied to the North Carolina specimens of *P. duorarum* by Burkenroad (1949). He reported the presence of a reddish-brown pigmented spot located at the juncture of the third and fourth abdominal segments of *P. duorarum* (Figure 3) as a simple test to distinguish this species from *P. aztecus*. The name "brown-spotted shrimp" is associated with the inshore Gulf of Mexico specimens of *P. duorarum* and the name "pink-spotted shrimp" is often applied to the offshore specimens. We have seen many specimens of *P. duorarum* lacking abdominal spots. Figure 4 shows a specimen with a faint indication of a spot. Idyll (1950) reporting on *P. duorarum* from the Tortugas grounds, stated that after death the spots fade and are not visible on most individuals by the time they are shipped from Key West.
- b. The presence of an abdominal spot must be used cautiously as the sole diagnostic test to distinguish *P. duorarum* from *P. aztecus*. Specimens of *P. aztecus* from the east coast of Florida and Apalachicola Bay, and possibly other areas, often bear abdominal spots as shown in Figure 5.
- c. The small rock shrimp, *Sicyonia dorsalis*, (Figure 6) from the Tortugas grounds, generally shows an abdominal spot; specimens of *Trachypeneus constrictus* from the same area often have spots. These two very small species have not been reported in the commercial catch, therefore, are not listed in Table I.
- d. Samples of penaeids from Cuba, examined by Eldred, showed specimens of *Penaeus duorarum* (Form B) with very light tan to dark abdominal spots. Some specimens contained no spots (Figure 7a). Specimens of *P. brasiliensis* (Figure 7b) also showed tan or blue spots more prominent in some cases than those of *P. duorarum*. Higman (1959) reported that commercial quantities of "pink-spotted shrimp", *P. brasiliensis*, were taken in depths of about 23 to 40 fathoms along the coast of Surinam. Holthuis (1959) described *P. brasiliensis* specimens from Surinam and French Guiana as reddish in color with dark red abdominal spots.

GRADING OF SHRIMPS

According to Idyll (1950) it is important to distinguish and separate the common domestic shrimps (*Penaeus setiferus*, *P. duorarum*, and *P. aztecus*) for market purposes because of price differences.



Figure 6. *Sicyonia dorsalis*, Tortugas, Florida, with abdominal spot (lateral view).



Figure 7. a. *Penaeus duorarum* (Form B), Cuba, with no abdominal spot (lateral view).



b. *P. brasiliensis*, Cuba, with abdominal spot (lateral view).

Clifford (1955) and the U. S. Fish and Wildlife Service (1959) reported a price differential between domestic shrimps, with the "non-grooved white shrimp" generally bringing higher prices than the "grooved pink and brown shrimps". One member of the industry, however, informed us that, generally speaking, "white and pink shrimps" command a higher price than "brown shrimp". We were also informed that some markets will only take certain colors of shrimps.

Before 1947, the bulk of the domestic catch consisted of the white colored shrimp, *P. setiferus*, with *Xiphopeneus kroyeri*, and *Penaeus aztecus*, making up the remainder. These two latter species were rarely sold on the fresh market because of color or size, but were dried, canned or peeled. The first large catches of the brown colored shrimp, *P. aztecus*, from the coast of Texas in 1947, were refused by many dealers because of color. Lyles (1951) reported on the educational efforts used to overcome the consumers' resistance to the brown colored shrimp. According to Hildebrand (1955) the first catches of the pink colored shrimp, *P. duorarum*, from the Campeche Banks were refused because of marketing difficulties.

Since most consumers have little knowledge of the species of shrimps, and have rarely seen shrimps with the heads on, it is evident that this price differential is not based on the choice of species, but on the consumers' preference of size and color. A survey by the U. S. Fish and Wildlife Service (1959), on the consumers' preference of shrimps, listed size and color as the most important factors, with freshness and taste of product following next.

Although it is not the aim of this report to establish standards for proper grading of domestic and foreign frozen raw headless shrimps, the following aspects should be considered by those persons involved with this problem:

1. The method of grading domestic and foreign shrimps by use of color may be questionable, in regards to promoting fair marketing practices, for several reasons: First, different species of both grooved and non-grooved penaeids could be graded as white shrimps because of color, consequently, the consumer would, at times, possibly pay a higher price for the same species when colored white than when colored brown, blue, green, etc. Second, many different species of both the tribes Penaeidea and Caridea assume, at times, the same color, therefore, if only color was used to describe the product, the consumer would have no assurance of receiving the same product at each purchase.

2. The use of common names to identify the product is worthless since many species bear the same common names; also, different common names are often associated with one species.
3. The application of scientific names to grading of domestic shrimps is possible because of our knowledge of species that are produced in this country. The "tails" or abdominal portions of the commercial domestic species contain distinguishing characters; therefore, the "tails" of each species may be separated. If both the scientific name and the color were used to identify the product, it appears that this method would be more conducive to promoting fair marketing practices.
4. Although Table I shows a tentative list of foreign commercial penaeid species, we have no knowledge of how many of these are being imported into the United States. It is probable that the species of the genus *Penaeus* constitute the bulk of the imports of frozen raw headless shrimp at this time. However, to determine the feasibility of applying scientific names to the foreign shrimps, a thorough study of the species from each country is necessary.

ABDOMINAL CHARACTERS FOR IDENTIFYING THE DOMESTIC COMMERCIAL SHRIMPS (FAMILY PENAEOIDAE)

Springer and Bullis (1956) reported that 30 penaeid species were collected during the exploratory operations by the OREGON in the Gulf of Mexico and adjacent waters from 1950 to 1955. Included in these collections were many offshore species obtained in depths to 930 fathoms. In addition to the commercial shrimps collected, other species, small in size or few in number, were obtained from inshore estuarine areas to a depth of 70 fathoms.

Voss (1955) included 19 species in his key to the domestic commercial and potentially commercial shrimps (family Penaeidae). Voss referred to *Penaeus schmitti* as a domestic species; however, Burkenroad (1936b) and Holthuis (1959) described *P. schmitti* as a southern species occurring in the Caribbean area and the Atlantic coasts of Central and South America. This species was not recorded by Springer and Bullis (1956). However, a few pounds of *P. schmitti* specimens were obtained from the Atlantic, offshore Cape Canaveral, Florida, (Harvey Bullis, Jr., personal communication) during an exploratory trip in 1956 and again in 1957. This species was taken in 30 fathoms along with *P. aztecus* and *P. duorarum*.

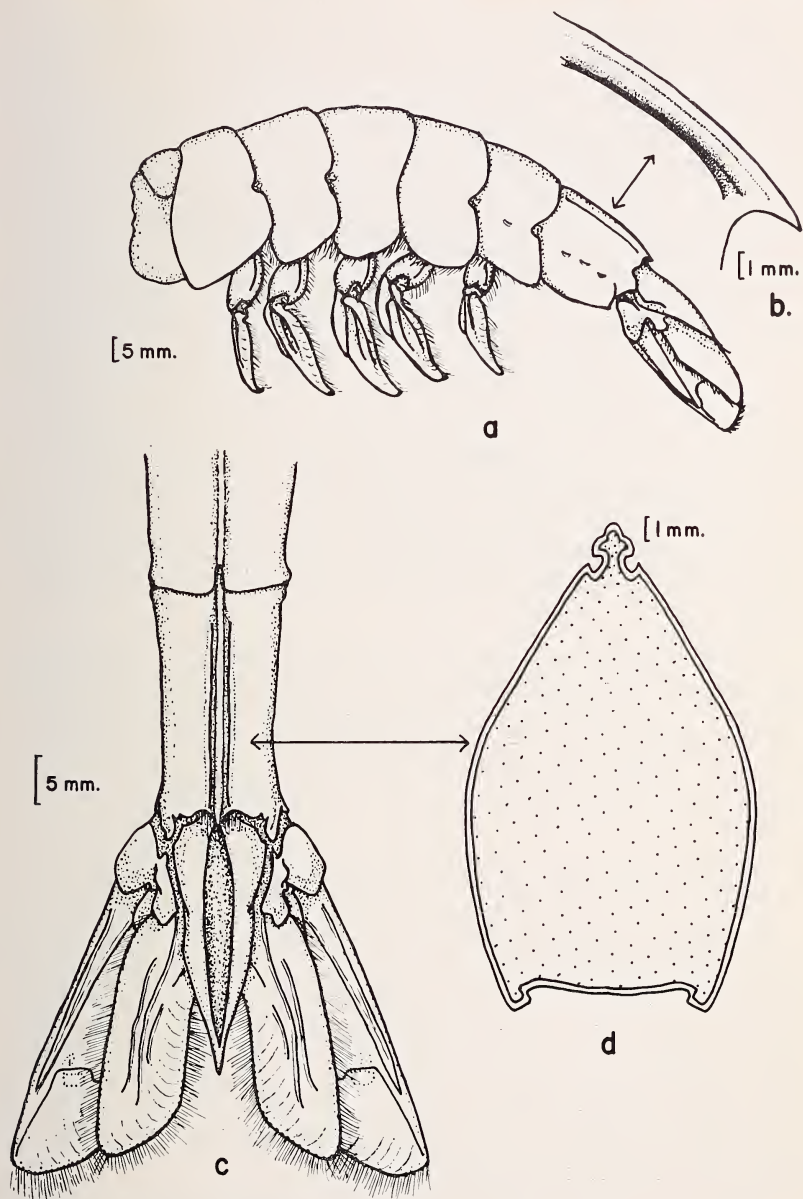


Figure 8. *Penaeus duorarum* (Form A).
 a. abdominal portion (lateral view).
 b. posterodorsal part of 6th abdominal segment (lateral view).
 c. posterior part of the abdomen (dorsal view).
 d. 6th abdominal segment (cross section).

Three grooved penaeids (*P. brasiliensis*, *P. duorarum* and *P. aztecus*) were included by Voss as domestic species. Prior to the studies of Burkenroad (1939) the name *P. brasiliensis* was applied to all grooved penaeids from the north and south Atlantic. Burkenroad separated this *P. brasiliensis* group into *P. duorarum* (Forms A and B), *P. aztecus* (Forms A, B and C) and *P. brasiliensis*. In Table I the geographical distribution of the above species is based on the studies of Burkenroad (1939). According to Burkenroad, *P. brasiliensis* does not occur in the Gulf of Mexico. He reported, however, the presence of this species from Atlantic North America (based on one male specimen obtained from offshore Cape Hatteras by the ALBATROSS from 13 fathoms on October 19, 1874). Examination by Eldred of many thousands of grooved domestic penaeids has failed to disclose any specimens of *P. brasiliensis*. This species was not collected by Springer and Bullis (1956).

Although many species of penaeids have been reported from the Gulf of Mexico and Atlantic North America, it is doubtful that more than seven species are of commercial importance at the present time.

The illustrations in Figure 8 through Figure 14 are based on adult specimens of these seven species. The total length in millimeters (from the tip of the rostrum to the tip of the telson) is given for each shrimp. The scale in millimeters used for each drawing is indicated. The abdominal parts of a penaeid shrimp are labeled in Figure 1.

Penaeus duorarum (Form A) grooved shrimp, Figure 8

Figure 8 is based on a 190 mm. female specimen from the Tortugas grounds. Figure 8b, shows the structure of the narrow grooves related to this species. Figure 8c, illustrates the position and structure of the median dorsal carina or ridge and the two narrow grooves adjoining the carina of the 6th abdominal segment. Figure 8d, a cross section cut through the 6th abdominal segment at the place indicated by the arrow, further illustrates the narrow, channel-like nature of the grooves.

The lateral edges of the telson shown in Figure 8c are smooth and devoid of spines. The exo-skeleton of this species is smooth and shiny.

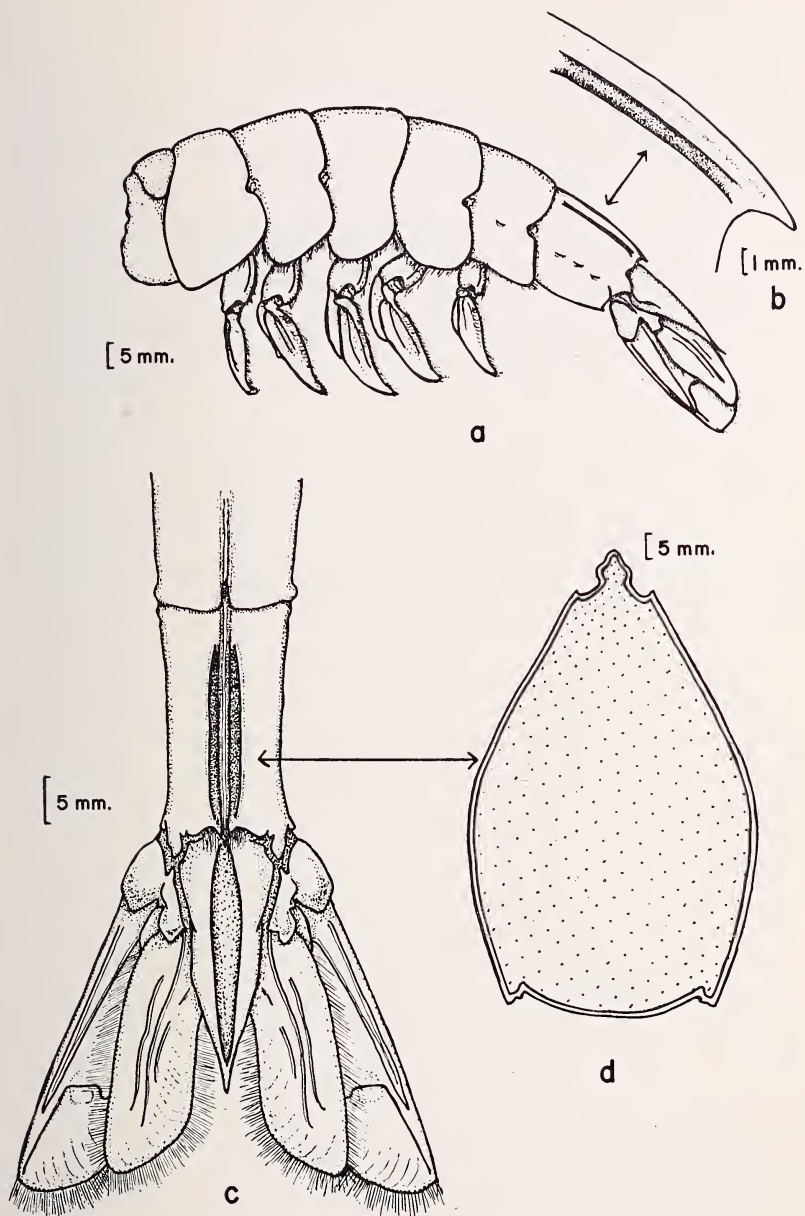


Figure 9. *Penaeus aztecus* (Form A).

- a. abdominal portion (lateral view).
- b. posterodorsal part of 6th abdominal segment (lateral view).
- c. posterior part of abdomen (dorsal view).
- d. 6th abdominal segment (cross section).

P. duorarum (Form B) from foreign fisheries (Table I) has abdominal grooves different from those of *P. duorarum* (Form A). The structures of the grooves of *P. duorarum* (Form B) were described by Burkenroad (1939).

Penaeus aztecus (Form A) grooved shrimp, Figure 9

Figure 9 is based on a 190 mm. female specimen from the Campeche banks. Figure 9b shows the structure of the open, wide grooves related to this species. In Figure 9c and 9d, the two wide grooves along the median dorsal carina of the 6th abdominal segment may be noted.

The lateral edges of the telson of this species lacks any spines (Figure 9c). The exo-skeleton is smooth and shiny.

The abdominal grooves of *P. aztecus* (Form B and C) from foreign fisheries (Table I) are not alike and both are different from the grooves of *P. aztecus* (Form A). Burkenroad (1939) described the grooves of the Forms B and C of *P. aztecus*.

Penaeus setiferus, non-grooved shrimp, Figure 10

Figure 10 is based on a 167 mm. female specimen from the coast of Texas. Figure 10b and 10c, shows the presence of the dorsal carina and the absence of a groove. The indentation of the ventral margin of the 1st abdominal segment (Figure 10a) of this species does not occur on this segment of *P. duorarum* and *P. aztecus*.

The lateral edges of the telson (Figure 10c) contain no spines. The exo-skeleton is smooth and shiny.

P. schmitti (Table I) is very similar to *P. setiferus*. However, Burkenroad (1939) reported that the structure of the ventral margins of the 1st abdominal segments of these two species are not alike.

Trachypeneus similis, Figure 11

The abundance of this small sized species in the Tortugas area was reported by Ingle *et al* (1959) and from the Campeche area by Hildebrand (1954). Eldred (1959) found "tails" of this species mixed with "tails" of *Penaeus duorarum* in boxes of commercially frozen shrimp. Being "pink" in color, *Trachypeneus similis* could possibly be mistaken for the young of *Penaeus duorarum*; therefore, distinguishing abdominal characters of *Trachypeneus similis* are included here.

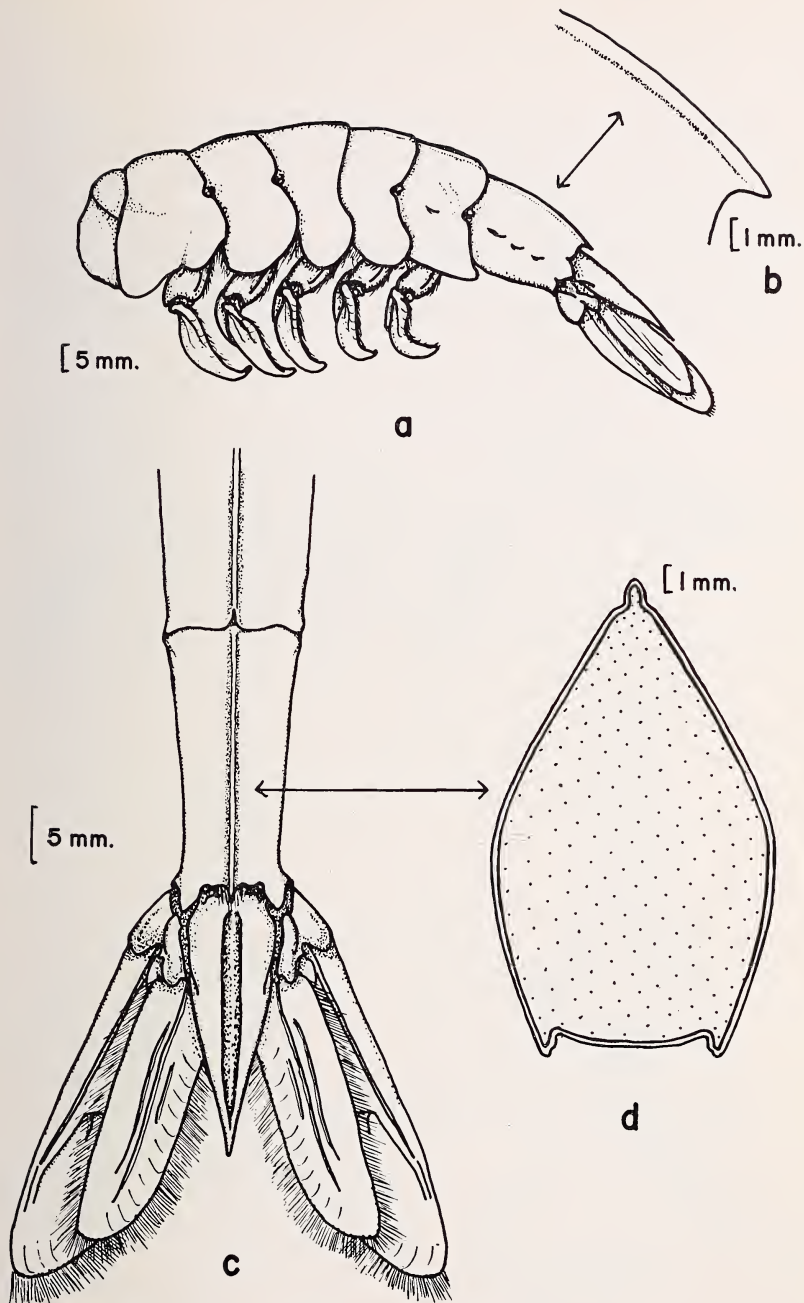


Figure 10. *Penaeus setiferus*.

- a. abdominal portion (lateral view).
- b. posterodorsal part of 6th abdominal segment (lateral view).
- c. posterior part of the abdomen (dorsal view).
- d. 6th abdominal segment (cross section).

Figure 11 is based on an 86 mm. female specimen of *T. similis* from the Tortugas grounds. Located on the lateral edges of the telson (Figure 11b) are three pairs of small spines and one pair of large spines. Very fine bristly hairs are concentrated on the 4th, 5th, 6th abdominal segments, the telson and the uropods. By running a finger over the posterior part of this species the bristly nature of these hairs may be denoted. The exo-skeleton is rather dull in appearance.

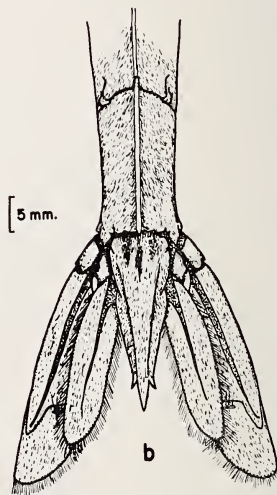
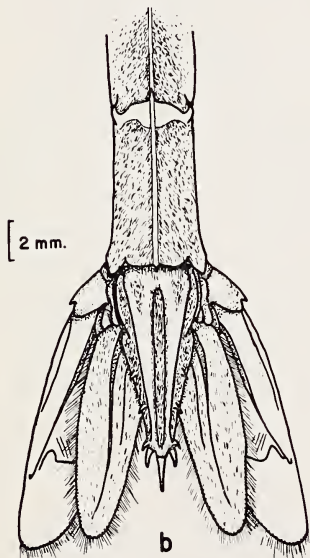
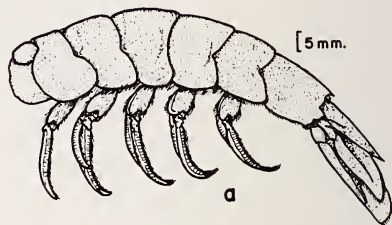
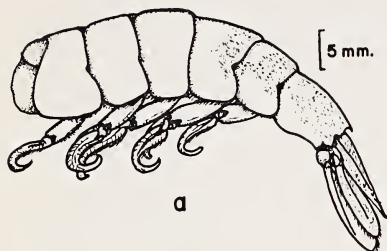


Figure 11. *Trachypeneus similis*.
 a. abdominal portion (lateral view).
 b. posterior part of the abdomen (dorsal view).

Figure 12. *Hymenopenaeus robustus*.
 a. abdominal portion (lateral view).
 b. posterior part of the abdomen (dorsal view).

Hymenopenaeus robustus, royal red shrimp, Figure 12

Figure 12 is based on a 178 mm. female specimen from offshore Jacksonville, Florida (depth 300 fathoms). One pair of spines occur on the lateral edges of the telson (Figure 12b). The entire body of this species is covered with very fine hairs that are soft to the touch. The exo-skeleton has a dull velvet-like appearance.

Xiphopenaeus kroyeri, sea bob, Figure 13

Figure 13 is based on a 110 mm. femal specimen from offshore Apalachicola Bay, Florida. This species may be distinguished by the dorsal spines located on the posterior part of the 4th and 5th abdominal segments (Figure 13a and 13b). The difference in the dorsal and ventral structure of the 1st abdominal segment in contrast to the other species described here may be noted in Figure 11a. The pleopods or swimming legs are quite long in proportion to the size of the body of this species. The exo-skeleton is smooth and shiny.

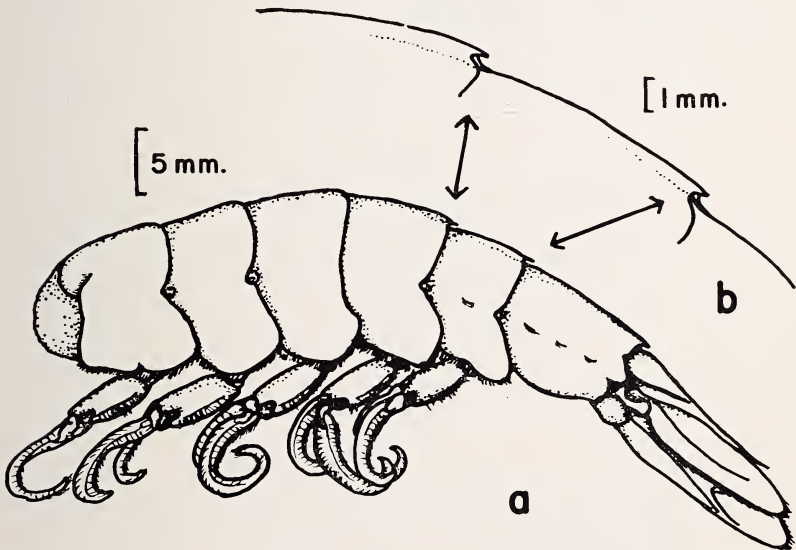


Figure 13. *Xiphopenaeus kroyeri*.

a. abdominal portion (lateral view).

b. dorsal part of 4th and 5th abdominal segments (lateral view).

Sicyonia brevirostris, rock shrimp, Figure 14

Although other species of rock shrimp occur in the domestic waters, they are too small to be of commercial value. Catches of *S. brevirostris* ranging from approximately 25 to 30 shrimp (heads off) to a pound were reported by Lunz (1957).

Figure 14, a lateral view of an 85 mm. male specimen from the Tortugas grounds, illustrates the deep sculptured abdominal grooves and many tubercles. The body is covered with soft fine hairs. The thick hard shell has a chalk-like appearance.

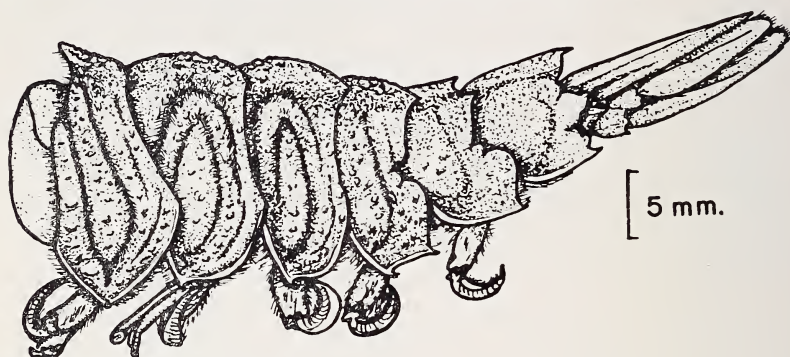


Figure 14. *Sicyonia brevirostris*.
abdominal portion (lateral view).

SUMMARY

Reliable abdominal characters for identifying the domestic commercial species (family Penaeidae) are described and illustrated. The general distribution of 66 species of 15 genera (family Penaeidae) reported from domestic and foreign shrimp fisheries are listed. Vernacular terms, common color names, and abdominal characters of commercial shrimps (tribes Penaeidea and Caridea) are discussed.

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